**Level 2: Adoption**

# Monitoring Coral Reefs - Establishing a Baseline


## Summary

**Grade Level: 6-8**

**Teaching Time:**

**Three 45-minute periods**

This teacher-led lesson invites students to become "Citizen Scientist" scuba divers to monitor corals in situ in actual assigned reef locations over a period of years. The lesson will introduce students to coral reef biology, how to identify conditions of stress in coral reefs, and how researchers monitor coral reef health.


## Objectives

- Students will learn about the particular susceptibility of corals to stress caused by changes in temperature.
- Students will understand the basic processes behind coral bleaching.
- Students will learn how to establish baseline information.

## Focus Questions

- What does a healthy coral reef look like?
- Why is the process of symbiosis important to the health of corals?
- What is coral bleaching?
- How do scientists monitor the health of a coral reef?
- Why is the collection of baseline data important?

## Climate Literacy

Organisms survive in specific ranges of temperature, precipitation, humidity, and sunlight. Organisms exposed to climate conditions outside their normal range must adapt or migrate, or they will perish (CL 3a)[5].

5 *Climate Literacy: The Essential Principles of Climate Science*, Second Version: March 2009. http://www.globalchange.gov/browse/educators

## Background (Teacher)

As highlighted in the previous lesson, part of the value of remote sensing is that sea surface temperature data can be analyzed over large areas to determine patterns and changes in reef system health. However, researchers also need to monitor coral reefs in situ, or right at the reef site. In this lesson, students will learn that part of the value of monitoring corals in situ is the ability to ground-truth remote satellite data and establish baselines.

In order to monitor coral bleaching and establish baseline data in situ, students need an introduction to coral biology, which includes the important process of symbiosis between corals and certain algae. Use the following information to explain to students the symbiotic relationship between corals and algae during Step 3 of the Procedure. Corals are animals that have a close relationship with plants, algae called zooxanthellae, which live within the coral polyp and give the coral its color. In this partnership, the plants (zooxanthellae) and the animals (coral polyps) rely on each other for survival. The coral polyp gets much of its food energy from the zooxanthellae, and the zooxanthellae, in turn, get a safe place to live and the nutrition they need to grow. The zooxanthellae also help recycle the coral's carbon dioxide and waste. When two species form a partnership with one another, the relationship is called symbiosis.

Because of the symbiotic relationship between coral and zooxanthellae, coral reefs, the largest skeletal structures built by animals, are very successful. But despite their success, corals are subject to environmental stresses, such as prolonged high sea surface temperatures, that can affect the symbiotic process.

Under the environmental stress of rising water temperature, coral polyps may expel the zooxanthellae from their bodies. The affected coral colony appears to whiten or lose its color. This is called coral bleaching. If the bleaching persists over a long period of time, the lack of algae and food stresses the coral, slowing growth and eventually killing the polyps.

Introduce the three activities in this lesson:

- Activity 2.1: Building a Model Coral Head
- Activity 2.2: How to Establish a Baseline and Monitor a Coral Reef Location
- Activity 2.3: Citizen Scientist Researchers Coral Reef Monitoring Simulation

## Vocabulary

**Algae –** plant or plant like chlorophyll-containing non-vascular organisms.

**Baseline Data** - a quantitative level or value from which other data and observations of a comparative nature are referenced.

**Climate Variability** - natural ranges in climate that fall within the normal range of extremes for a particular region, as measured by temperature and the frequency of precipitation events.

**Coral Bleaching** - loss of zooxanthellae due to stress caused by increased sea surface temperature.

**In situ** - on site at an actual location.

**Monitoring** - sampling and measuring something in the environment (air, water, soil, vegetation, animals) over time and comparing findings with baseline samples.

**Mutualism** - mutually beneficial association between two species of organism.

**Pin Site** - coral location where scientists make repeated visits to observe coral health.

**Polyp** - a single coral organism that secretes calcite, which forms a corallite shell or skeleton. Many polyps together make up a coral colony.

**Quadrat Sampling** - a classic tool for the study of ecology; in general, a series of squares of a set size are placed in a habitat, and the species within those quadrats are identified and recorded.

**Symbiosis** - a relationship between two species of organisms in which both members benefit from the association (mutualism), in which only one member benefits but the other is not harmed (commensalism), or in which one member benefits at the expense of the well-being of the other (parasitism).

**Temperature** - important abiotic factor affecting distribution and abundance of organisms; influences metabolic rate and affects rate of growth and reproduction.

**Zooxanthellae** - a group of dinoflagellates living endosymbiotically in association with one or a variety of invertebrate groups (e.g., corals). In corals, they provide carbohydrates through photosynthesis, which are one source of energy for coral polyps. They also provide coloration for corals and help corals recycle waste materials.

## Activity 2.1: Building a Model Coral Head

### Materials

- **Bulletin board**
- **White egg cartons**
- **Paper towel rolls cut into 3 sections** (1 per student)
- **Construction paper divided in half** (1/2 per student)
- **Colored pencils (green)**
- **Long balloons** (4 per student)
- **Colored and white tissue paper**
- **Scotch tape**
- **Teacher Master 2.1.1: Cross-Section of a Coral Polyp**
- **Student Master 2.2.1: Coral Reef Monitoring Sheet** (from Activity 2.2, for teacher reference only)
- **Student Master 2.1.1: Build a Model Coral Head** (1 per student)

Students build model coral polyps and a coral head to learn about the structure and biological interactions of coral polyps and the ongoing symbiosis in the coral community.

## Preparation

1. Download a copy of **Teacher Master 2.1.1: Cross-Section of a Coral Polyp** for computer projection. Alternatively, you can make a transparency of the master.

2. Build a bulletin board display of a coral reef. Before students construct their individual coral polyp models, prepare a space on a bulletin board to display built coral heads. Title the bulletin board display: What Is Coral Bleaching? Turn white egg cartons upside down with the bottom cups facing up, and cut a hole in each cup the diameter of a paper towel roll. Staple sets of egg cartons on opposite sides of the bulletin board. Label one side "Living Coral" and the other side "Bleached Coral." The egg cartons represent the skeletal structure where students will attach their coral polyp models to make coral heads. The "living" coral head will contain colored twisted tissue paper surrounding the coral polyps attached by the students. The "bleached" coral skeletal remains of the polyps will have no soft body parts, only white twisted tissue paper woven around the egg carton cups attached by students.

**Note:** To make different coral head shapes (branching, boulder, plate, or fleshy coral) for the insertion of student made polyps, refer to **Student Master 2.2.1: Coral Reef Monitoring Sheet** for ideas.

## Procedure

1. Display **Teacher Master 2.1.1: Cross-Section of a Coral Polyp** on a computer screen and use the bulletin board display "What Is Coral Bleaching?" as a teaching tool for the model coral heads presentation.

2. Point out key features of the coral polyp using the master image:

- The coral polyp is an animal that has tentacles, mouth, gut, body cavity, interconnecting tissues, and a limestone skeleton.
- The coral polyp is mostly transparent with no pigment of its own.
- At night, tentacles come out of the polyp and capture food. During the day, the tentacles move into the body cavity.
- The inside wall of the polyp is attached to the outside wall with interconnecting tissue.
- Zooxanthellae live in the walls of the interconnecting tissue.
- Limestone builds up where the polyp secretes calcite, forming the reef skeleton.
- The skeleton houses millions of polyps on a reef system. (Point out the egg cartons representing the reef structure in the bulletin board display.)

3. Review with students the information in Teacher Background about the symbiotic relationship between coral polyps and microscopic algae called zooxanthellae. The zooxanthellae live in the polyp's interconnective tissue (point this out on the projected image) and use photosynthesis to make food from sunlight, water, and carbon dioxide, which the polyp and zooxanthellae share.

4. Tell students that they will build a model of a coral polyp. Distribute **Student Master 2.1.1: Build a Model Coral Head**. Follow the directions on the master.

5. Once students have assembled their coral polyp models, ask them to:
   - Identify the coral polyp structure.
   - Explain the process of the symbiotic relationship between corals and zooxanthellae.
   - Explain why the process of symbiosis helps keep the coral reef healthy.

6. Divide the students into teams and have each team attach their coral polyps to a coral head represented by one egg carton on the "Living

Coral" side of the bulletin board.

7. Have students recall what they learned about sea surface temperature in the satellite mapping activity. Ask:

What is the average temperature range corals need to live?

*Answer: 18°C to 29°C*

Make a label for the bulletin board, “Water Temperature: Range 18°C to 29°C.” Attach it to the "Living Coral" side of the board.

8. Ask students what they think would happen if the sea surface temperature rose above 29°C by 1° or more.

- For one hour?
- For 2 days?
- For 2 months?

Explain that when the water is too warm the coral polyp expels the zooxanthellae. Ask:

What happens when the zooxanthellae are no longer inside of the coral?

*Possible answers:*

- *They can't carry on photosynthesis to feed the coral and take away the polyp’s waste products.*
- *The color of the coral is lost and it turns white.*
- *The coral is under stress.*
- *The coral and zooxanthallae are no longer in a symbiotic relationship.*

Explain that the loss of the zooxanthallae leads to coral bleaching. The zooxanthallae are the source of the coral’s color. So when coral polyps, under environmental stress, expel the symbiotic zooxanthellae from their bodies, the affected coral colony appears to whiten. If the bleaching persists, the lack of algae and food stresses the coral, restricting growth

and eventually bleaching the polyps. Point to the right side of the board that contains the bleached coral.

9. Have the students look at the model coral reef on the bulletin board. Ask:

Is there any evidence of serious coral bleaching anywhere on the display?

*Possible answers:*

- *On the "Bleached Coral" side, there is no color, only the polyp skeletons.*

Make another label for the bulletin board, "Water Temperature: 1°C Higher Than Highest Summer Temperature." Attach it to the "Bleached Coral" side of the board.

10. As a class, go over the Discussion Questions from Master 2.1.1.

Why are coral polyps important to coral health?

Why is the symbiotic relationship between animal and plant important to coral health?

*Possible answers:*

- *When two species form a partnership with one another, the relationship is called symbiosis.*
- *The coral polyp gets much of its food energy from the zooxanthellae, and the zooxanthellae, in turn, get a safe place to live and the nutrition they need to grow.*
- *The zooxanthellae help recycle the coral's carbon dioxide and waste.*

## Activity 2.2: How to Establish a Baseline and Monitor a Coral Reef Location

### Materials

- **Teacher Master 2.2.1: Coral Quadrat Example**
- **Teacher Master 2.2.2: Unbleached and Bleached Coral Examples**
- **Student Master 2.2.1: Coral Reef Monitoring Sheet** (1 per student)
- **Student Master 2.2.2: Coral Health Key** (1 per student)

Students learn how to examine an actual in-situ coral reef monitoring site using a coral health key needed to determine coral color and a monitoring sheet needed to record baseline information.

## Preparation

Download the images of **Teacher Master 2.2.1: Coral Quadrat Example and Teacher Master 2.2.1b Bleached and Unbleached Coral Examples** to be projected from your computer.

## Procedure

1. Project **Teacher Master 2.2.1b Unbleached and Bleached Coral Examples**. Point out the differences between the bleached coral example and the healthy coral example. Guide students to understand that Image 1 shows a golden color, indicating it is living, while Image 2 is white, indicating the coral is bleached. Explain that the students will be learning how to identify corals under stress of bleaching in the next activity just like researchers do.

2. Project the **Teacher Master 2.2.1: Coral Quadrat Example**. Ask students to examine the coral quadrat and describe the area. Write down all responses and add anything the students miss.

*Possible descriptions:*

- *There are 9 quadrats, or the image is divided into 9 sections.*
- *There are corals in all quadrats.*
- *One large coral is in quadrat #5.*
- *There are different shaped corals.*
- *There are different colored corals.*
- *Under the coral, there seems to be the same kind of material, maybe coral skeleton/polyps.*
- *Latitude and longitude are shown.*
- *The name of the coral reef site is listed.*

Ask students: Do you see any other living organisms beside corals?

*Answer: Yes, algae surrounding coral*

How many different colors of corals do you see?

*Answer: Accept any number of colors*

3. Tell students they are going to learn how to conduct a baseline study of a coral reef. Pass out the tools students will use to explore the values included in the baseline: **Student Master 2.2.1: Coral Reef Monitoring Sheet** and **Student Master 2.2.2: Coral Health Key**.

4. Explain to students that they will fill in the **Student Master 2.2.1: Coral Reef Monitoring Sheet** recording observations from the projected coral quadrat image with the data it contains.

- To begin tell students to fill in the "Site name" and "Citizen Scientists' names "that refer to their school and themselves on the Coral Monitoring sheet.
- Have students fill in the "Reef name and location" which is La Parguera, Puerto Rico at 18.05 N latitude and 67.05 W. longitude found on the projected image.
- Use the date from the image (No exact time is given).
- Add Pin # 123 on the monitoring sheet. The Pin or Tag number indicates that the coral site has been monitored in the past and has observations already recorded from a different date that can be used to compare new readings.

5. Next, tell students that they will use **Student Master 2.2.2: Coral Health Key** to monitor and log in information regarding the coral sample and color code on Student Master 2.2.1: Coral Reef Monitoring Sheet. Explain that the Coral Health Key is a four-sided card with a different color of coral on each side, either lighter or darker in color to represent degrees of coral health. Emphasize that corals with color are considered healthy.

Procedure for using the Coral Health Key:

- Choose a random coral in quadrate #5 featured on the projected coral quadrat image.
- Look at the coral and select an area.
- Hold the Coral Health Key next to the selected area and find the closet color match.
- Record the identified coral and coral color on the Student Master 2.2.1 Coral Reef Monitoring Sheet in the 3 column data box:
  - Coral Number, Quadrat 5
  - Color Code, B1 or B2
  - Coral Type: Boulder

6. Continue the monitoring activity by discussing theese questions:

Look at quadrat # 5. Is there any evidence of coral stress or bleaching? What are your observations?

*Possible answers:*

- *The boulder coral has a B1 reading taken with the Coral Health Key. This "light" color might indicate possible future coral stress, including bleaching.*

Do any other quadrats show colors found on the Coral Health Key?

*Possible answers:*

- *Quadrat #4 has a smaller boulder coral that has a reading of B1. Part of the coral in quadrat #5 has the same reading.*

Are the corals in quadrats #4 and #5 living? Declining? Dead? Do you need to conduct further monitoring to answer this question?

*Possible answers:*

- *We need to examine more samples at the site, at different times taking earlier quadrat readings before the image we are observing or conducting a future monitoring to see if the corals changed.*

How does in situ monitoring, or being at an actual reef site, help scientists establish a baseline to use for future comparisons?

*Possible answers:*

- *Scientists need to establish a baseline reading at the site, in order to assess what is going on at the time, but also to compare the baseline reading to future yearly monitoring events to see if change is taking place.*

## Activity 2.3: Citizen Scientist Researchers Coral Reef Monitoring Simulation

### Materials

- **Teacher Master 2.3.1: Coral Monitoring Image Sets** (1 per class)
- **Teacher Master 2.3.2: In Situ Data Log Sheet with Locations**
- **Student Master 2.2.1: Coral Health Key** (reuse from Activity 2.2, at least 1 per team)
- **Student Master 2.2.2: Coral Reef Monitoring Sheet** (copy from Activity 2.2, 3 per team, one for each dive)
- **Student Master 2.3.1: Citizen Scientist Coral Reef Mission** (1 per student)
- **Clipboards** (1 per team)
- **Safety goggles used as swim goggles** (1 pair for each student "diver")
- **Masking tape**

Students simulate a field survey in which they become Citizen Scientist Researchers, checking and monitoring the health of corals in assigned reef locations over a period of years. This interactive activity assesses students' ability to apply their knowledge of coral reef biology and coral monitoring techniques, as they record quantitative baseline data and make predictions of possible coral bleaching events.

## Preparation

**Note:** This activity can be approached in two different ways, depending on the grade level: 1. Simulated dive to In-Situ or Pin sites as activity features, or 2. Pin sites displayed on computer for direct student observations**.**

1. Print a copy of the coral images in Teacher **Master 2.3.1: Coral Monitoring Image Sets**. The locations are:

- Set A: Stetson Bank, Pin 26
- Set B: Stetson Bank, Pin 37
- Set C: Panama, Tag 218

2. Pick three classroom quadrat locations and label them A, B, and C to correspond with the three image sets.

3. Use masking tape to tack down coral reef image #1 (for the first year) of each set in the appropriate location.

**Note:** Teams will monitor their assigned reef site three times during this activity. Each monitoring event represents a different year. You will need to change the reef image between each monitoring event.

## Procedure

1. Divide students into three teams and assign each team a coral reef monitoring site: A, B, or C.

2. Pass out copies of **Student Master 2.2.1: Coral Health Key**, **Student Master 2.2.2: Coral Reef Monitoring Sheet**, and **Student Master 2.3.1: Citizen Scientist Coral Reef Mission**, plus a clipboard and safety goggles (swim goggles) for the team of reef divers.

3. Have students read **Student Master 2.3.1: Citizen Scientist Coral Reef Mission** to prepare for the dive to their assigned reef survey site. Answer any questions students may have.

4. Direct each team to its reef location. Have teams record their Site Name on the monitoring sheet.

5. Have Citizen Scientists begin their dives to survey their reef sites. Remind students that each team will monitor their site for three different years. The first year, the team will collect baseline data, so they can determine if any changes are taking place in the next two dive years.

**Note:** To keep track of the three different monitoring years, you may wish to have students fill in Year 1, Year 2, and Year 3 for the "date of survey" on the **Coral Reef Monitoring Sheet** or provide students with the dates from **Teacher Master 2.3.2. In-Situ Data Log Sheet for their assigned site.**

6. Have teams follow the instructions under Multiple Coral Dives to Coral Location on **Student Master 2.3.1**, and complete the **Coral Reef Monitoring Sheet** for the first year.

7. Change the coral image, and have teams repeat the survey procedure, for Year 2. Change the image again, and have students complete their surveys for Year 3. Make sure students work with a new **Coral Reef Monitoring Sheet** for each dive.

8. When students have collected data for all three years, ask them to use their data to answer the questions under Putting Your Data Together on the master.

9. Discuss team findings as a class by asking the following questions:

What can you tell about the health of your reef from your baseline data? Give observations.

*Possible answer:*

- *You can tell what is happening at that moment in time through evidence such as coral types, coral color, location, and degree of coral color.*

What can you tell about the health of your reef each year? Present observations. .

*Possible answer:*

- *Because teams are looking at the same location, we will be able to detect change from year to year.*

How does using the quadrat sampling method help monitor the health of a coral reef?

*Possible answer:*

- *Scientists can pinpoint the same precise coral location from one monitoring time to the next.*

From your observations of each year's data, can you tell if your reef has changed over time?

*Possible answer:*

- *Answers will vary; it may stay the same, bleach, or return to health.*

Why is it important to have baseline data to measure if change happens?

*Possible answer:*

- *If there is no baseline information, you would only be guessing if change is taking place.*

10. Provide class time for teams to complete the section, Reporting Your Coral Health Findings, on the master. Then have teams report out to the class.

Student team class reports must include the following:

- What a healthy coral reef looks like
- What proof the team has that the reef is healthy
- How first year baseline data supported the following years' findings
- What evidence teams found of the consequences of rising and falling water temperature on coral health.

**Note:** Remind students to download and project reef images from their monitoring scenario as part of their class report.

Different outcomes will be seen for each testing site over the three-year monitoring period. For each monitoring event, the teams will select from three choices: healthy reef, declining reef, dead reef. Possible outcomes to choose from within a year are as follows:

- Year 1 : healthy reef; : declining reef; : dead reef.
- Year 2: healthy reef; : declining reef; : healthy reef.
- Year 3: healthy reef; : declining reef; : declining reef.

**Teacher Master 2.1.1**

# Cross-Section of a Coral Polyp

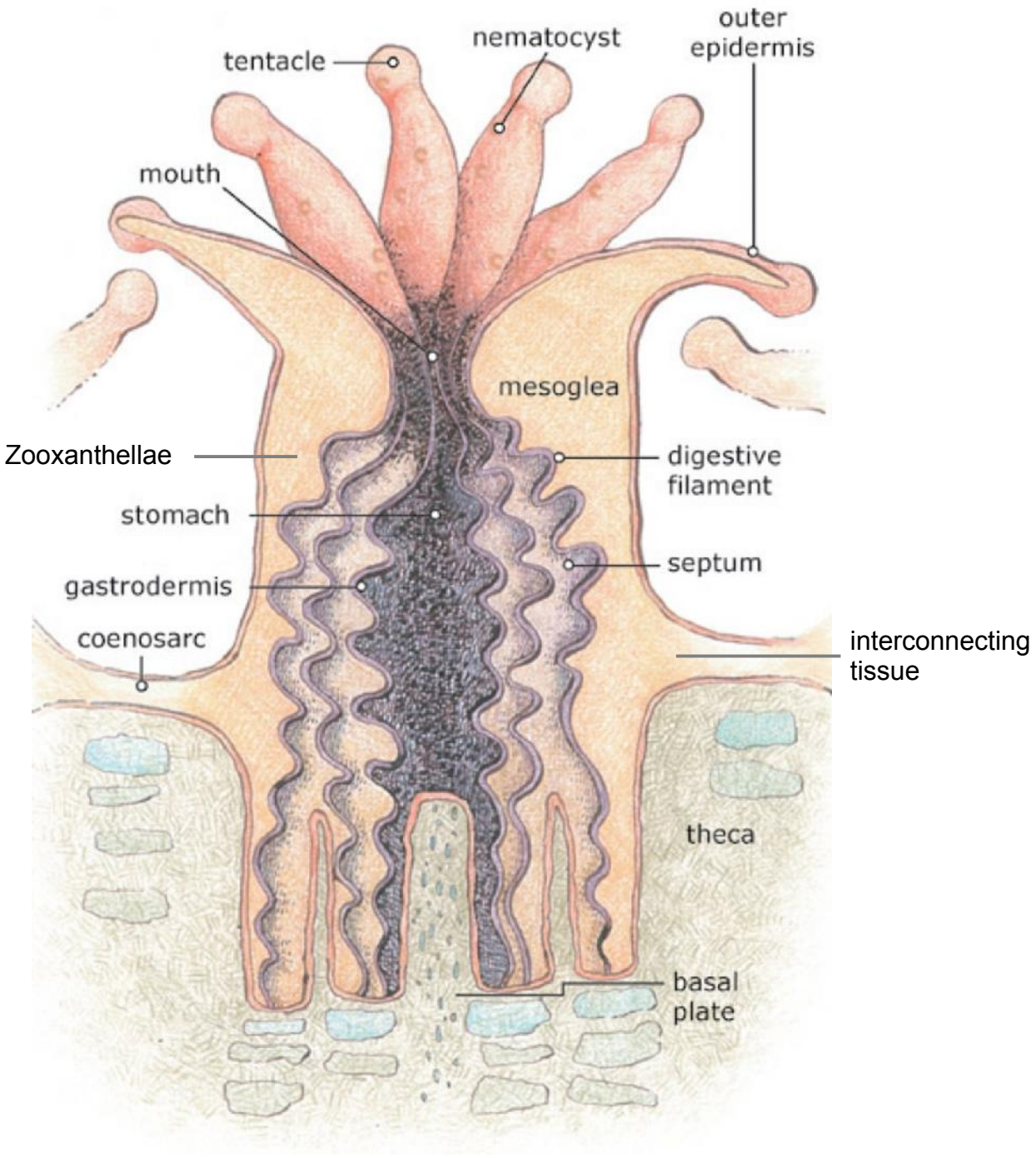
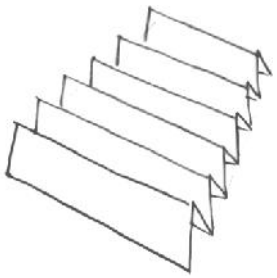



Image: NOAA

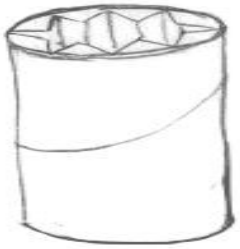
**Student Master 2.1.1**

# Build a Model Coral Head

1. Fold a piece of construction paper in half and accordion pleat it. Use a green colored pencil to draw circles on one side of the paper. These circles represent zooxanthellae. Zooxanthellae are algae that live inside of corals. They provide carbohydrates through photosynthesis, which give energy and color to the corals.

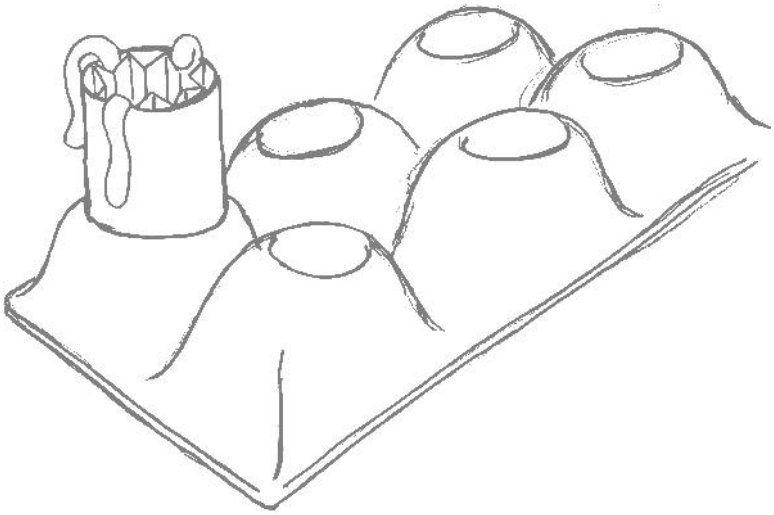


2. Hold the ends of the accordion-pleated construction paper together to form a cylinder with the zooxanthellae on the outside. Next, adjust the cylinder to fit inside of the paper towel roll. Cut off any excess paper from the top and bottom of the tube. The accordian-pleated inside of the cylinder forms the gut of the polyp.



3. Tape 4 long un-inflated balloons to the inside of the cylinder at one end. These are the tentacles. The tentacles feed the coral at night when there is no sun to allow the zooxanthellae to carry out photosynthesis.

4. To build a coral head, insert your coral polyp into the skeletal structure (egg carton) on the What Is Coral Bleaching? bulletin board display. Put tentacles inside of the polyp to signify day time when the zooxanthellae is making food. Before leaving class or school, put tentacles outside of the polyp for nighttime feeding.



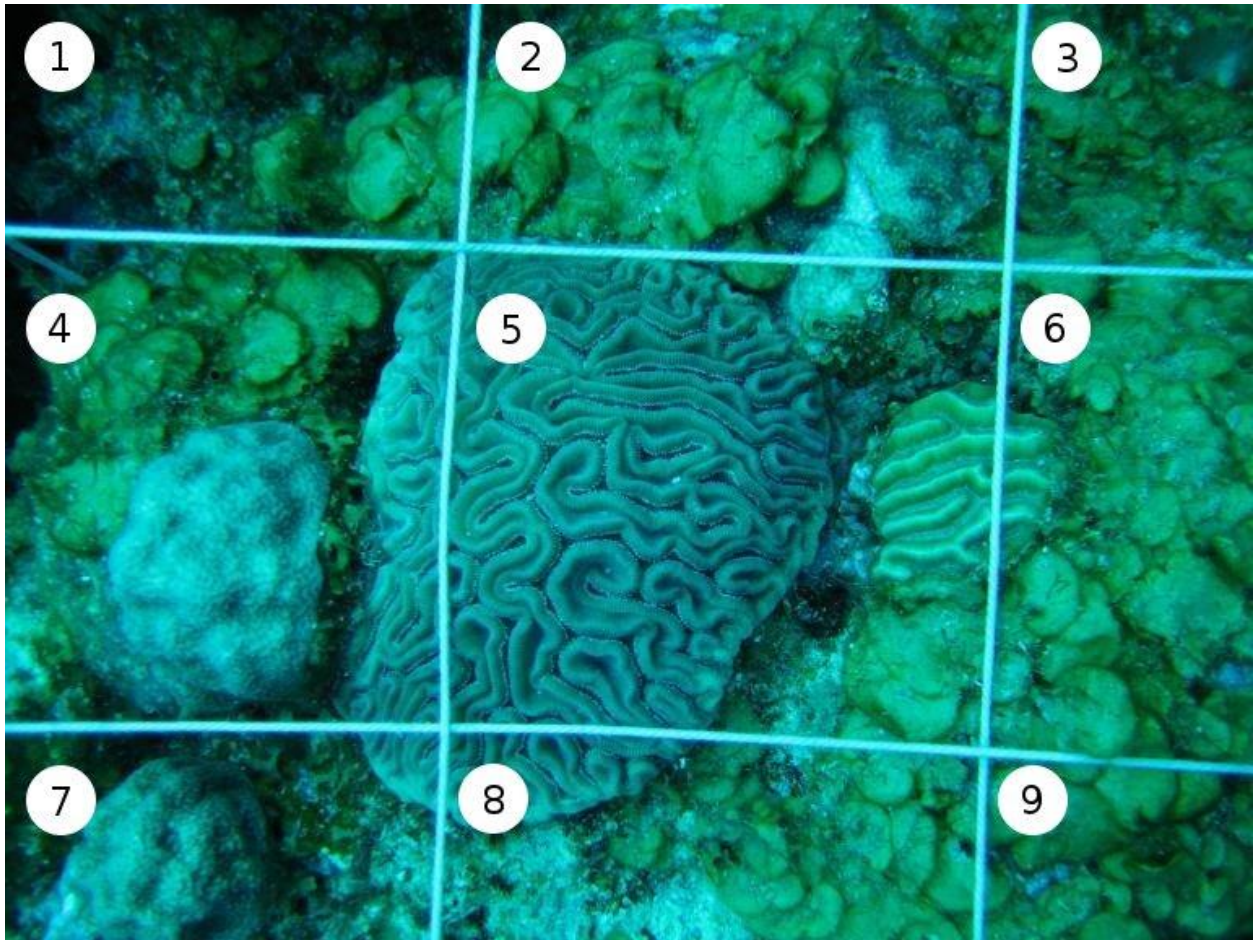
**Discussion Questions**

Why are coral polyps important to coral health?

Why is the symbiotic relationship between animal and plant important to coral health?

**Teacher Master 2.2.1**

# Coral Quadrat Example

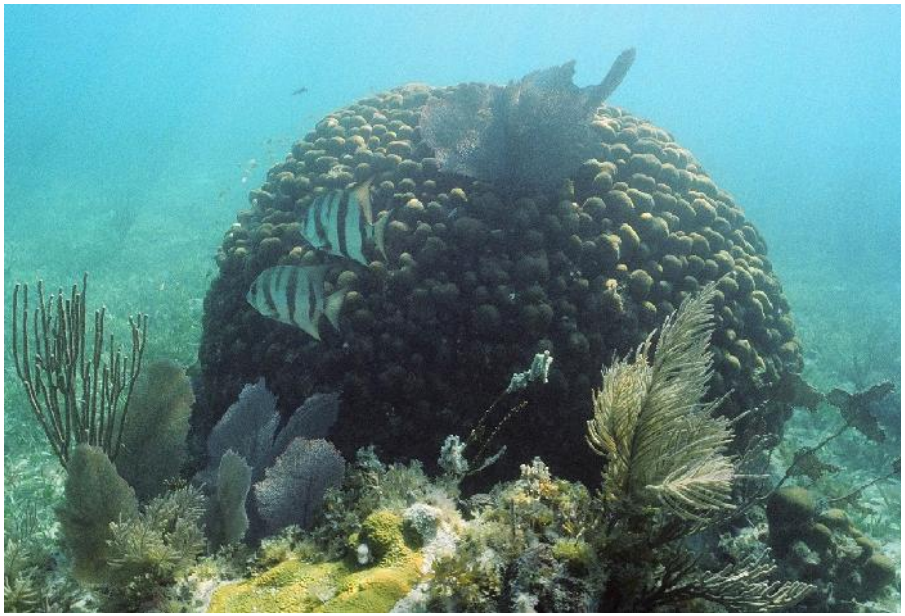



Dive date: January 2008

Survey Pin 123
La Parguera, Puerto Rico
18.05 N, 67.05 W

Image: NOAA Center for Coastal Monitoring and Assessment Biogeography Team

# Unbleached and Bleached Coral Examples



## Unbleached Coral

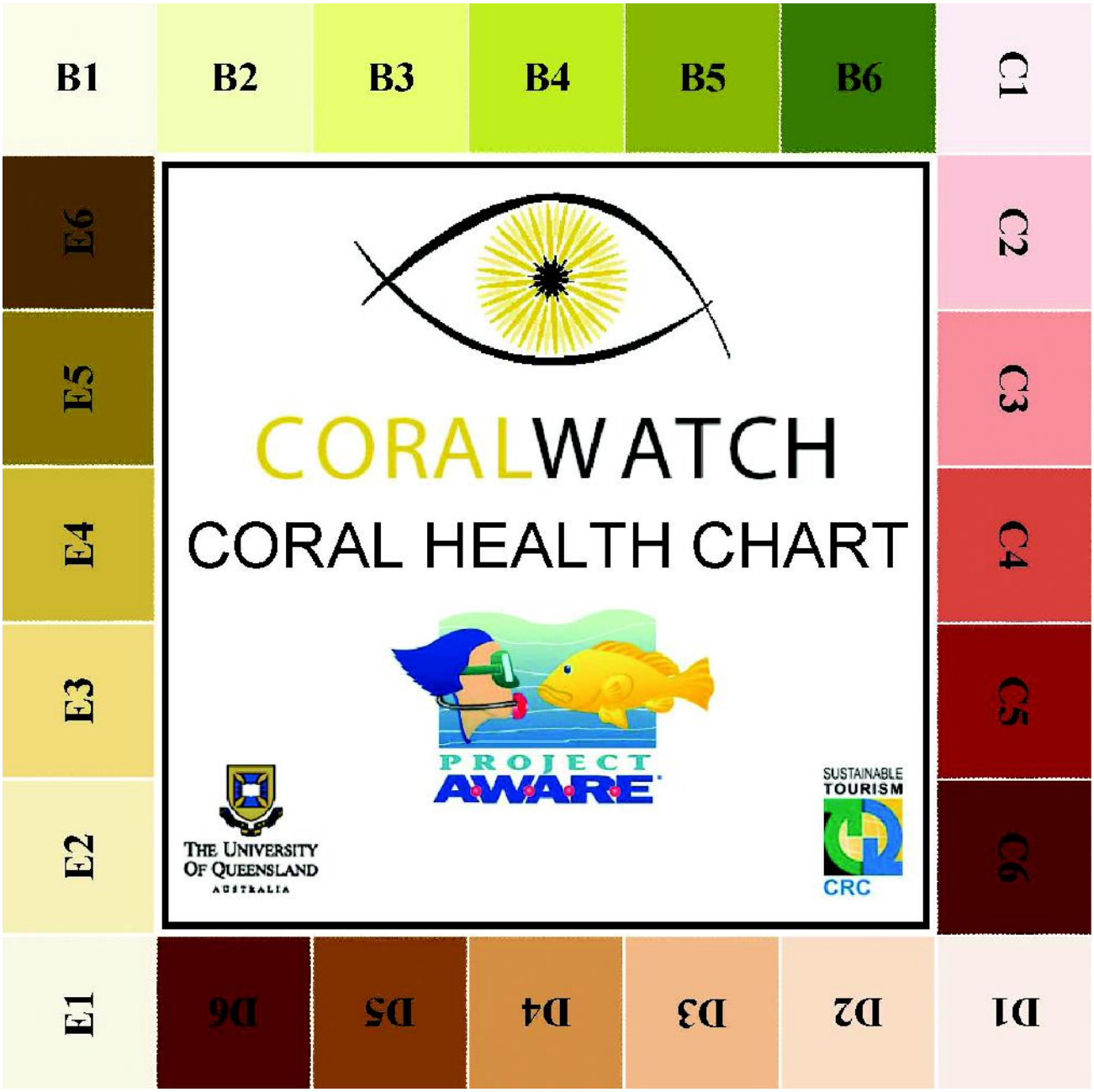
Image: Bill Precht, Florida Keys National Marine Sanctuary

## Bleached Coral

Image: NOAA Center for Coastal Monitoring and Assessment Biogeography Team

**Student Master 2.2.1**

# Coral Health Key




Coral Health Key developed by CoralWatch: www.coralwatch.org

**Student Master 2.2.2**

# Coral Reef Monitoring Sheet

Site name: _____

Citizen Scientists' names: _____

Reef name and location: _____

Latitude: _____ Longitude: _____

Date of survey: _____/_____/_____ Time collected (i.e., 14:00 or 2pm): _____
day month year

Your activity: snorkeling Weather: sunny / cloudy / raining

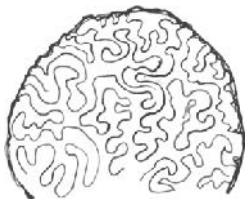
Coral Transect Tag or Pin Number: _____

| **Coral Number** | **Color Code** L=Lightest; D=Darkest | **Coral Type** Br = branching; Bo= boulder; Pl = Plate; So = Soft | | | |
|---|---|---|---|---|---|
| *example* | *L: D2* | *D: E5* | *Br* | *Bo* | *Pl* | *So* |
| 1 | L: | D: | Br | Bo | Pl | So |
| 2 | L: | D: | Br | Bo | Pl | So |
| 3 | L: | D: | Br | Bo | Pl | So |
| 4 | L: | D: | Br | Bo | Pl | So |
| 5 | L: | D: | Br | Bo | Pl | So |
| 6 | L: | D: | Br | Bo | Pl | So |
| 7 | L: | D: | Br | Bo | Pl | So |
| 8 | L: | D: | Br | Bo | Pl | So |

**Coral Types**

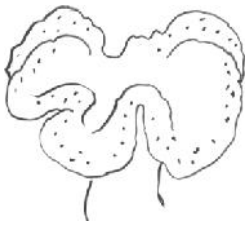
Branching

Boulder



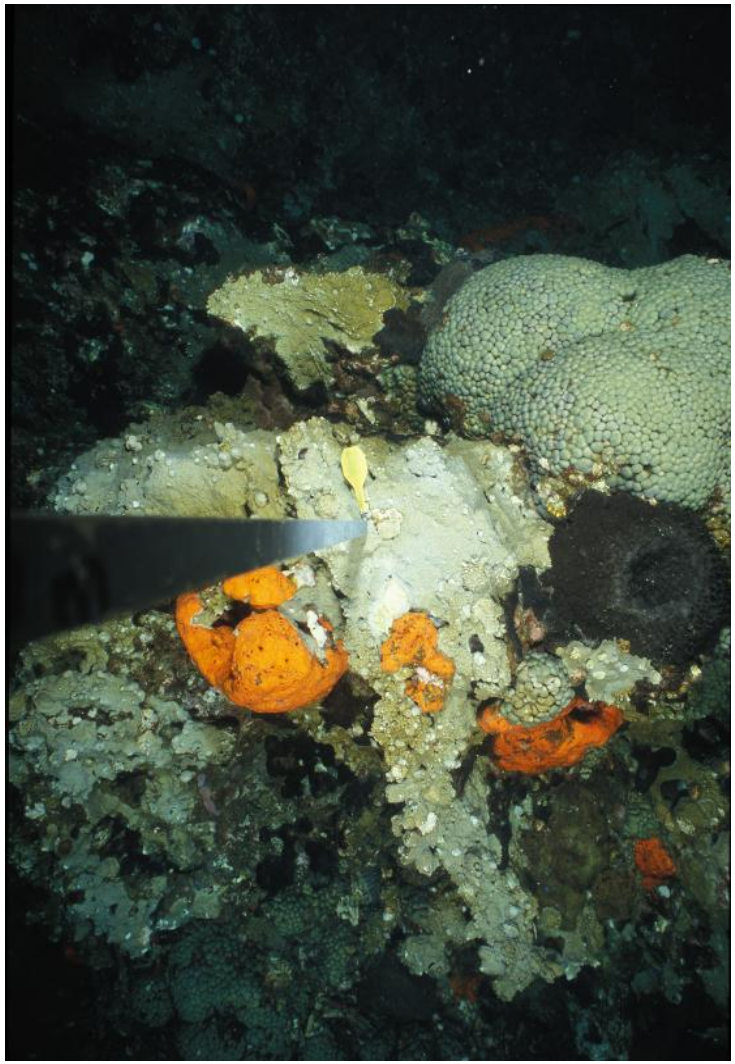
Plate

Soft / Fleshy



Coral Reef Monitoring Sheet adapted from CoralWatch: www.coralwatch.org

# Coral Monitoring Image Sets



## Reef Location: A

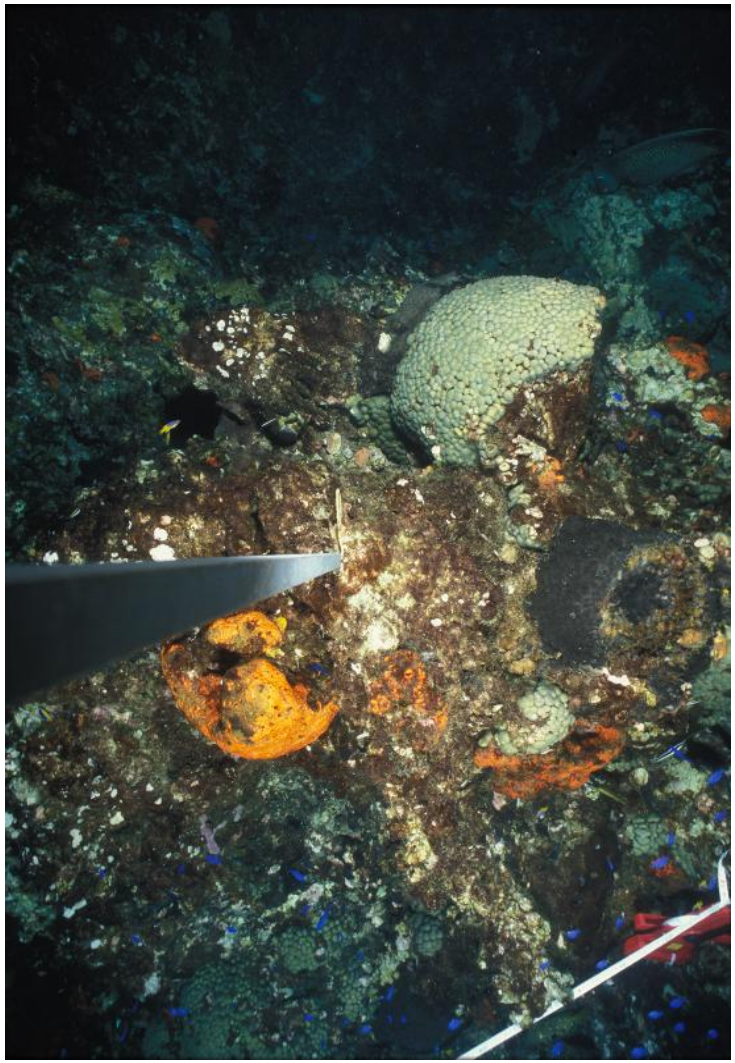
Dive date: June 2005

Survey Pin 26

Stetson Bank, Gulf of Mexico

28.0°N, 93.5°W

Image: Flower Garden Banks National Marine Sanctuary (FGBNMS)



# Reef Location: A

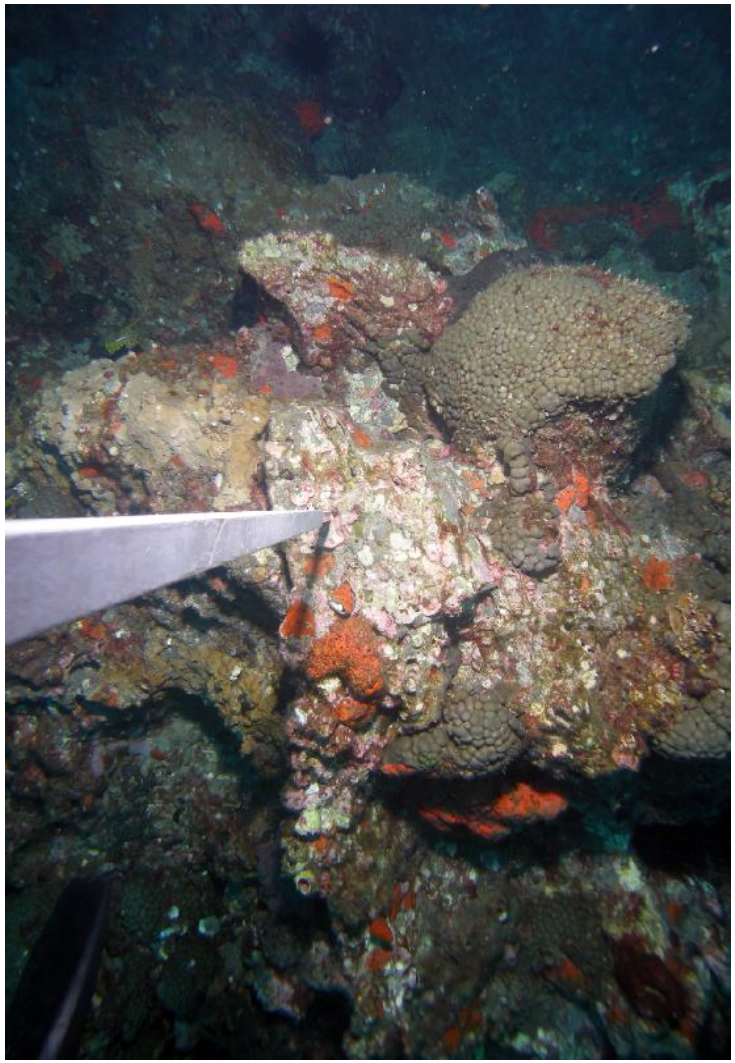
Dive date: June 2006

Survey Pin 26

Stetson Bank, Gulf of Mexico

28.0°N, 93.5°W

Image: Flower Garden Banks National Marine Sanctuary (FGBNMS)



# Reef Location: A

Dive date: March 2009

Survey Pin 26

Stetson Bank, Gulf of Mexico

28.0°N, 93.5°W

Image: Flower Garden Banks National Marine Sanctuary (FGBNMS)

## Reef Location: B

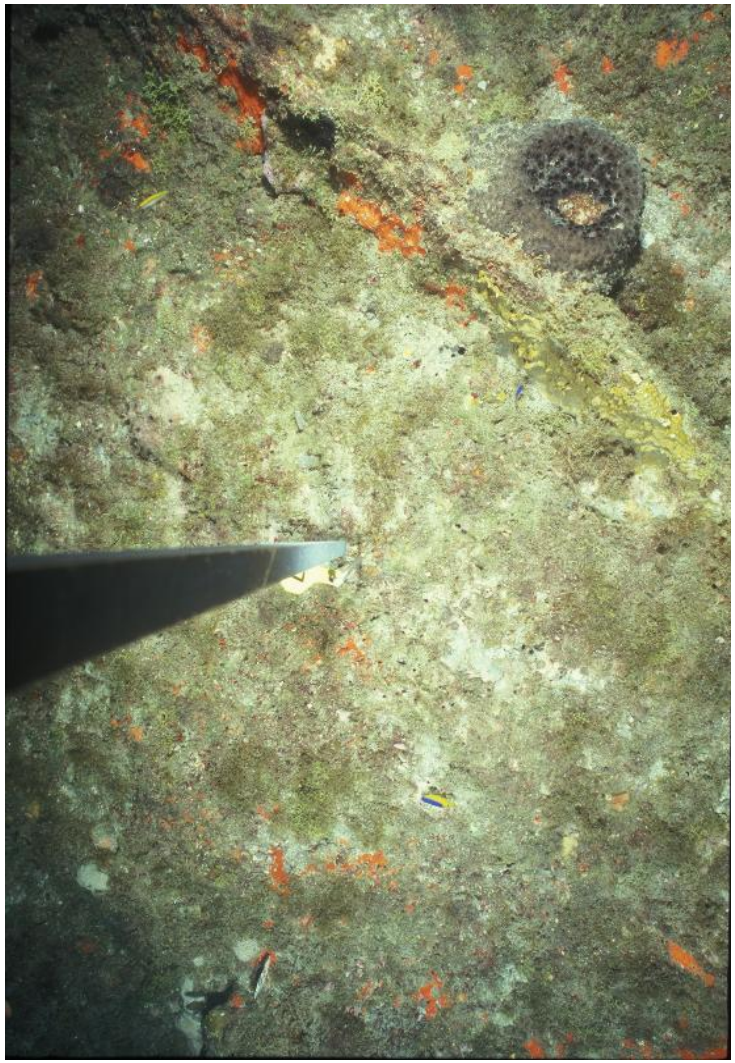
Dive date: September 2003

Survey Pin 37

Stetson Bank, Gulf of Mexico

28.0°N, 93.5°W

Image: Flower Garden Banks National Marine Sanctuary (FGBNMS)



## Reef Location: B

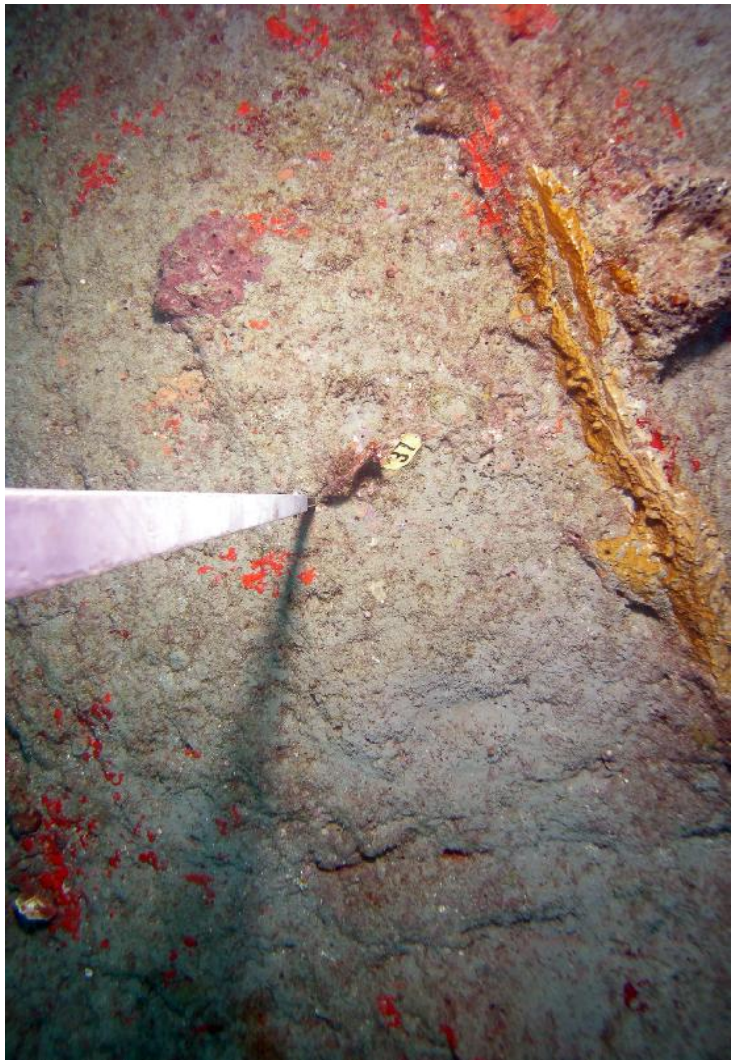
Dive date: July 2007

Survey Pin 37

Stetson Bank, Gulf of Mexico

28.0°N, 93.5°W

Image: Flower Garden Banks National Marine Sanctuary (FGBNMS)




## Reef Location: B

Dive date: March 2009

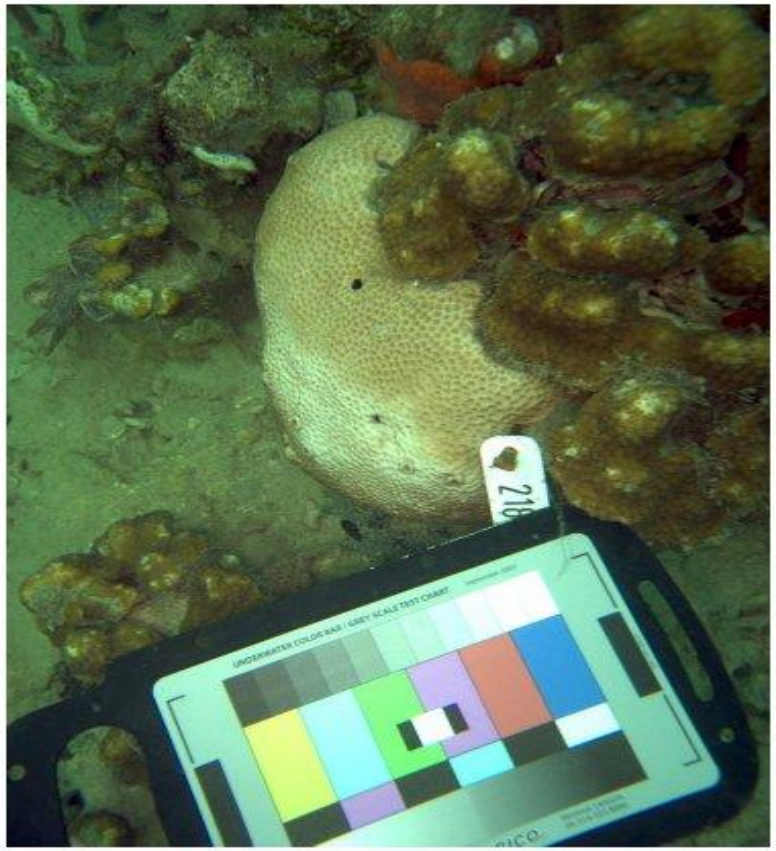
Survey Pin 37

Stetson Bank, Gulf of Mexico

28.0°N, 93.5°W

Image: Flower Garden Banks National Marine Sanctuary (FGBNMS)

# Reef Location: C




Dive date: 2005

Survey Tag 218

Panama

9.3°N, 82.2°W

Image: Benjamin P Neal, Catlin Seaview Survey

# Reef Location: C

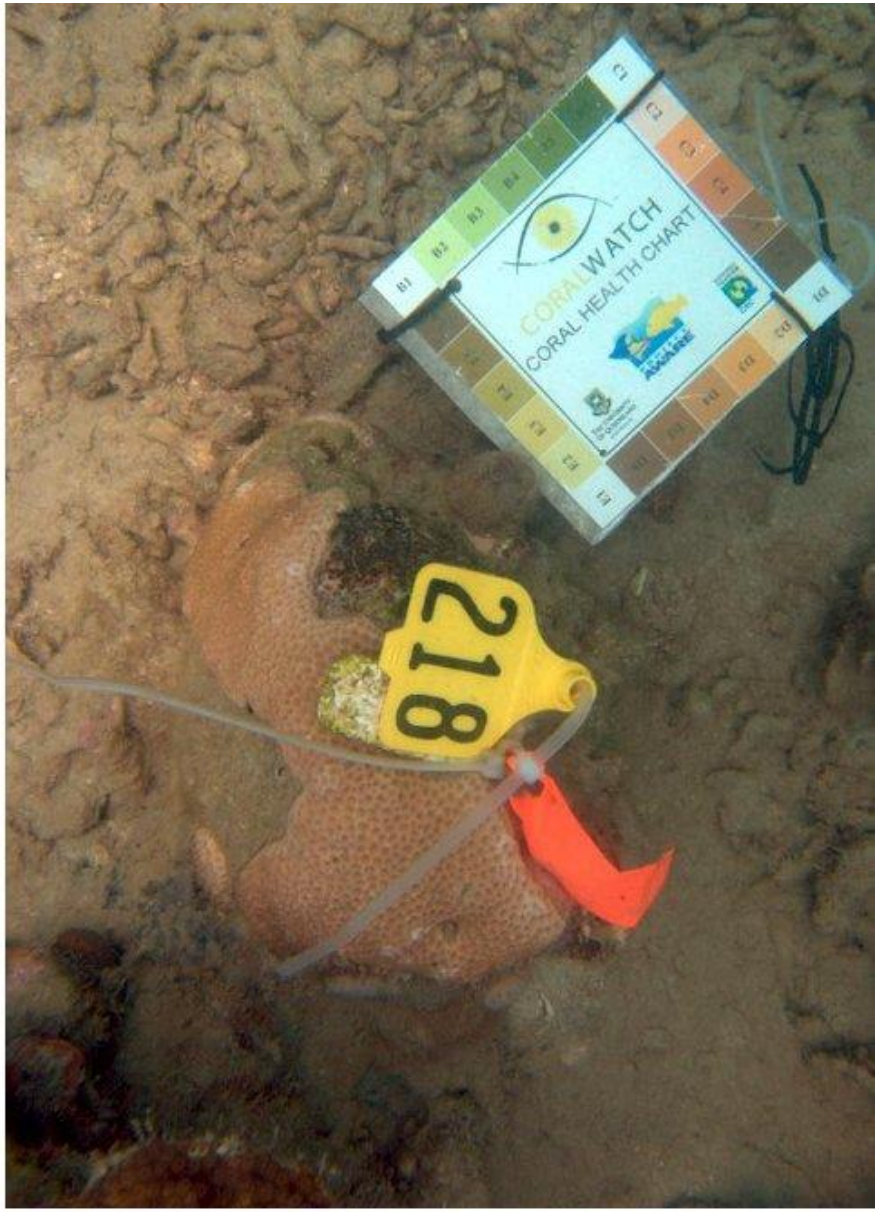

Dive date: 2006

Survey Tag 218

Panama

9.3°N, 82.2°W

Image: Benjamin P Neal, Catlin Seaview Survey




## Reef Location: C

Dive date: 2008

Survey Tag 218

Panama

9.3°N, 82.2°W

Image: Benjamin P Neal, Catlin Seaview Survey

**Teacher Master 2.3.2**

# In Situ Data Log Sheet with Locations

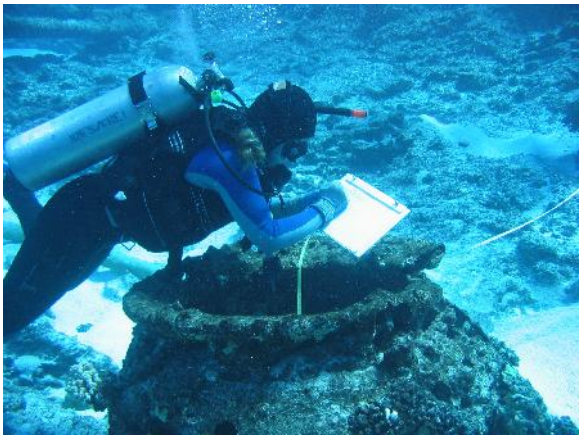
| Coral Reef Site A | Year/Month | Coral Reef Description (circle one) | | |
|---|---|---|---|---|
| Stetson Bank, Pin 26<br>28.0°N, 93.5°W | June 2005<br>(Baseline) | Healthy Reef | Declining Reef | Dead Reef |
| | June 2006 | Healthy Reef | Declining Reef | Dead Reef |
| | March 2009 | Healthy Reef | Declining Reef | Dead Reef |

| Coral Reef Site B | Year/Month | Coral Reef Description (circle one) | | |
|---|---|---|---|---|
| Stetson Bank, Pin 37<br>28.0°N, 93.5°W | Sept 2003<br>(Baseline) | Healthy Reef | Declining Reef | Dead Reef |
| | July 2007 | Healthy Reef | Declining Reef | Dead Reef |
| | March 2009 | Healthy Reef | Declining Reef | Dead Reef |

| Coral Reef Site C | Year/Month | Coral Reef Description (circle one) | | |
|---|---|---|---|---|
| Panama, Tag 218<br>9.3°N, 82.2°W | 2005<br>(Baseline) | Healthy Reef | Declining Reef | Dead Reef |
| | 2006 | Healthy Reef | Declining Reef | Dead Reef |
| | 2008 | Healthy Reef | Declining Reef | Dead Reef |

**Student Master 2.3.1**

# Citizen Scientist Coral Reef Mission



Congratulations! You have been chosen as a Citizen Scientist to join a team to monitor the health of coral reefs. You and your team will assume the role of Citizen Scientist coral reef biologists monitoring corals in selected ocean locations. Put on your goggles and get ready to take the plunge to observe coral health over time. Your mission is to monitor the same reef location over three different years to look for changes in coral heath.

Your question is, "Is there evidence of coral bleaching at my coral reef pin site?" Attach your **Coral Health Key** and three **Coral Reef Monitoring Sheets** to a clipboard. Fill in the information at the top of each monitoring sheet about your team and site location. Read over the procedures below and ask your teacher any questions you may have. Now you're ready to begin your dives.

***Multiple Dives to Coral Location***

1. Swim to your assigned coral reef site. Remember, you are underwater and can't speak. Use hand signals to communicate.
2. Observe your coral colony on site or from your computer and begin filling in your **Coral Reef Monitoring Sheet** for the first dive with information about the reef. Do you see any other living organisms beside corals? How many different colors of corals do you see?
3. Use your **Coral Health Key** to measure the health at your assigned coral site. Pick corals that will be easy to identify when you return to monitor the dive site again. Remember, you are looking for changes in specific colonies or coral heads over different years.
4. When you finish surveying, swim out of the quadrat area and return to your lab. Discuss your findings with your team. Record all data on your monitoring sheet. Your first data sheet is your baseline and represents Year 1. You will compare the data you collect from subsequent dives with this baseline data.
5. Repeat steps 1 through 4 two more times. Wait for a signal from your teacher to begin each new dive. Bring a new **Coral Reef Monitoring Sheet** to each dive to record observations. Each monitoring of the coral site represents a different year.

***Putting Your Data Together***

Organize and examine the three data sheets, one for each year. Use the questions below to guide your work:

- What can you tell about the health of your reef from your baseline data?
- How does using the quadrat sampling method help you monitor the health of a coral reef over time?
- From your observations of each year's data, can you tell if your reef has changed over time?
- Why is it important to have baseline data to observe if change is taking place?

***Reporting Your Coral Health Findings***

Your final step is to publish and present your team's findings for your peers.

1. First, analyze the data you collected to see if it tells the story of your coral reef's health. Use the Presentation Discussion Questions below to plan your presentation.
2. Next, share your data with your classmates. Use your collected data, vocabulary words, and your reef images as part of your presentation.
3. Complete the Data Log below, and present it as part of your report to highlight key information for each year and compare data from one year to another.

***Data Log***

| Coral Reef Site | Year/Month | Coral Reef Description (circle one) |
|---|---|---|
| Lat: , Lon: | (Baseline) | Healthy Reef Declining Reef Dead Reef |
| | | Healthy Reef Declining Reef Dead Reef |
| | | Healthy Reef Declining Reef Dead Reef |

***Presentation Discussion Questions***

Looking at all of the collected data, what can you tell about the health of the coral at this reef over time? What stays the same? What changes?

Can your team detect any consequences of rising or falling sea surface temperature on your monitored coral reef? Give evidence.

Is there evidence of coral bleaching taking place? Give evidence.

If coral bleaching is taking place, does it always mean the corals will die?

Why is coral research important?

How was your experience as a Citizen Scientist on this project valuable to you?